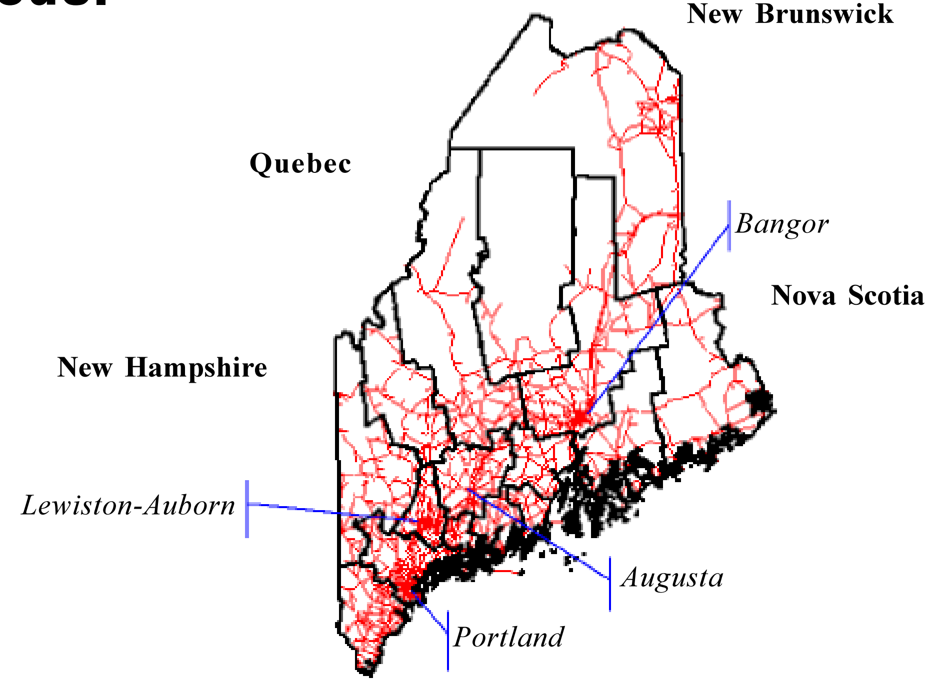
U.S. Department of Transportation
Federal Highway Administration
Office of Environment and Planning
Washington, DC 20590

September 1998
No. 4

Transportation Case Studies in GIS

Case Study 4: Maine Department of Transportation Statewide Travel Demand Model



Project Summary

The Maine Department of Transportation (Maine DOT) is in the process of developing a statewide travel demand model linked to a Geographic Information System (GIS). The travel demand model, based on the TRIPS modeling software, provides a standard forecast of statewide traffic growth that can be used to evaluate capital improvement projects and as inputs for air quality analysis. The Maine model is somewhat unique in that it addresses recreational travel patterns that lead to peak traffic and congestion during the summer tourist season. Development of the model required combining an initial, relatively simple statewide model with four existing models for Metropolitan Planning Organizations (MPOs). GIS software, including ARC/INFO and ArcView, was instrumental for combining the existing model networks into a unified statewide model with common format and coding conventions.

Project Benefits

- GIS serves as an excellent tool for integrating the four MPO models with the statewide model.
- Semi-automated routines were developed for converting the model network and attributes from TRIPS to ArcView and vice versa.
- The GIS has much greater display capabilities, enabling more effective visual review and reporting of the model inputs and outputs.
- The visual display of model outputs aided the model calibration.
- Linking the model to GIS also assures compatibility with Maine's TIDE system, a GIS-linked data warehouse currently under development.
- Evaluation of border crossing freight movements is better in GIS.
- Special models developed for modeling tourist traffic can integrate tourist centers and landmarks.

Project Overview

Background

In recent years, use of the roadway network has grown at a dramatic rate. At the same time, state and federal policies have placed greater emphasis on anticipating and planning for the social, economic and environmental impacts of the transportation system. To best address these issues, and to better meet the increasing importance of regional and statewide transportation planning, Maine DOT recognized the need to develop effective and efficient methods for predicting future use of the transportation network. To effectively support the Department's statewide planning process, Maine DOT, in coordination with the Maine Turnpike Authority, began the process of developing a statewide travel demand model in 1994.

Phase One of the project laid the groundwork for how best to proceed. A consultant was engaged to analyze and document options for proceeding with development of a statewide model. The goal of this phase was to produce a work plan to help foster statewide, multimodal travel demand modeling. The report described what the model should inevitably encompass (not necessarily the pathways to getting there), and included recommendations for a top-level structure for the modeling database. Based on the findings of Phase One, Maine DOT contracted the services of Parsons Brinkerhoff Quade and Douglas, Inc. to proceed with actual development of the statewide model. One component of the process would be to use GIS, where beneficial, to support model development and for presentation of the model's predictions.

Problem Definition

Prior to development of a statewide model, travel demand models had already been developed for Maine's four MPO's: Bangor Area Comprehensive Transportation Study (BACTS), Kittery Area Comprehensive Transportation Study (KACTS), Lewiston-Auburn Comprehensive Transportation Study (LACTS), and Portland Area Comprehensive Transportation Study (PACTS). However, it was determined that greater traffic forecasting ability was needed in less populated regions. Other factors contributing to Maine DOT's modeling needs included:

1. In Maine, urban population and employment are dispersing to the surrounding non-urbanized areas, altering travel patterns and increasing the need for in-depth review of potential transportation projects in those areas.
2. The movement of goods along Maine's transportation network is an important component of the state's economy. Interstate 95 is a major artery for the movement of goods from the Canadian Maritime Provinces and Quebec to New England and other eastern US states. Improved access to information related to the characteristics of these goods thus becomes a valued necessity. More and better information was needed for clearance and movement purposes, as well as for reporting and identification.
3. As requirements throughout the nation for air quality have become more rigorous, in turn so has the need for broader analysis of air quality impacts. Having travel demand data more readily available would assist in the state's evaluation of air quality impacts from major transportation projects.
4. Recreational and tourism travel constitutes a core economic resource for the state. The volume of recreational travel has been steadily increasing, and the most severe traffic congestion occurs as a result of recreational travel. New policies are under consideration for mitigating the impacts of recreational travel. The statewide travel demand model would enable better analysis of these impacts.
5. Existing MPO travel demand models would be substantially improved with external travel volumes that are based on socioeconomic variables, so that major roadway projects could be more easily and thoroughly evaluated.

These factors, along with several others, depict the clear need for a statewide model. A final factor of the equation further supporting the need for a statewide model centered on technology: specifically, integration within a GIS environment would enable broader capabilities for model development, calibration and display. It is important to note here that modeling statewide travel is a relatively new endeavor among state DOTs. GIS provides an excellent tool to supplement and enhance the modeling process, especially the integration of local model networks as described below.

Project Goals and Objectives

Through analysis of the project needs and feasibility, Maine DOT identified the following project goals and objectives:

Project Goals & Objectives

1. Obtain a standard forecast of statewide traffic growth so that all future feasibility studies will be working from a common base
2. Develop a direct link between the model and GIS
3. Specifically address recreational travel patterns
4. Obtain better estimates for the impacts of 'external' Traffic Analysis Zones (TAZs), which fall outside the state, or outside an MPO
5. Provide improved input to air quality conformity analysis
6. Enable evaluation of major projects beyond the MPO areas
7. Develop a model which can aid in resolving Maine Turnpike widening issues
8. Take advantage of previous work by incorporating MPO models into the statewide model, while standardizing on link classification on a statewide basis
9. Develop growth factors for projects at both the corridor and project levels.

Although there were several specific objectives for the project, the use and integration of GIS technology is the focus of this report. Described herein are the specific components, processes, and issues faced by Maine DOT as they relate to GIS. Several of the ways in which GIS was used for the project include:

- *Combine data*: GIS was used to process and combine existing data, including the travel demand models from the MPOs, Maine DOT's Transportation Integrated Network Information System (TINIS) data, and 1:24,000 USGS roads.
- *Move data*: the system enables the movement of data back and forth between the model and the GIS (e.g., facilitating updates and refinement of the model).
- *Display data*: GIS enables greater symbolization, formatting and flexibility for display of the model network, inputs and outputs. GIS helped to visualize and control the quality of the zone systems of each model. Developed from census data and municipal boundary files, GIS displays the model network and uses points to represent the centroids of the Traffic Analysis Zone polygons.
- *Review data*: improved display of data in GIS enabled more thorough quality assurance and control of the data, and thus improved calibration of the model data review included extensive network path validation testing using ArcView Network.
- *Provide more data*: GIS provides the ability to use additional data sources and display model-related data, which can support both efforts to improve data quality and provide a powerful mechanism for additional spatial analyses. GIS was also used to efficiently add network characteristics such as jurisdiction codes (county FIPS values provide more data through polygon-line overlay analysis.)

Existing Use of GIS at Maine DOT

The use of GIS technology within Maine DOT is increasing as more users emerge throughout the agency. GIS is currently being used for several purposes and projects.

Current GIS Capabilities

The Maine DOT GIS Unit resides in the Information Systems Division (ISD) of the Bureau of Finance and Administration. The GIS unit provides training, support, coordination, direction, data development, and application development assistance to all potential GIS users. It consists of a departmental GIS Manager and GIS Analyst. Two GIS support units have also been created where GIS use warrants the allocation of staff resources.

Maine DOT has standardized on ARC/INFO as their core GIS platform, with ArcView as their desktop viewing GIS (both by Environmental Systems Resource Institute, Redlands CA, USA). The Department's ARC/INFO GIS software and data were recently ported from a VMS environment to an Alpha NT environment. They are now using a true client-server architecture to access the GIS data through high-end PCs (e.g., 233 MHz with 32 MB of RAM) over the department's Local Area Network (LAN).

TIDE GIS-Linked Data Warehouse

The largest GIS-related initiative underway at Maine DOT is the development of a GIS-linked data warehouse, a project known as TIDE (Transportation Information for Decision Enhancement). The TIDE project is comprised of several phases. Phase I is focused on development of a data warehouse to be accessed by database query tools and a GIS interface, providing more flexible access to the department's legacy databases. TIDE Phase I databases consist of TINIS and the agency's Pavement Management System. TIDE will provide access to Maine DOT's legacy databases through multiple linear referencing methods, maintain historical data for trend analysis, provide both a standard and an ad hoc query environment, and have spatial query capabilities. Examples of applications envisioned for Phase I of TIDE include highway needs and adequacy reporting, vehicle occupancy queries, bicycle level of services queries, safety analysis, bridge analysis, local road assistance queries, and many others.

TIDE got underway in June 1997. The system is expected to be implemented during the beginning of 1999. Maine DOT anticipates integrating other GIS applications with the TIDE data warehouse, including, potentially, the statewide travel demand model. This integration would facilitate the update of model inputs, as well as enabling query and display of model outputs along with other data.

Other GIS Projects

Another core GIS activity centers on updating the Department's digital road centerline file. Maine DOT's road centerline base map was originally compiled from USGS quadrangle maps (scale 1:24,000) by the Maine Office of GIS, and is currently being refined by Maine DOT to provide consistency with the agency's link-node Linear Referencing System (LRS). Currently, all of the 55,000+ nodes and 70,000 links have been located and coded.

Maine DOT is quality testing the base map and resolving errors through programs that they have developed using ARC/INFO's Arc Macro Language (AML).

Several other GIS initiatives underway at Maine DOT include:

- A Right of Way (ROW) Project Tracking System
- Maine Natural Areas Program Screening Project
- Horizontal and Vertical Control Query System

As seen above the use of GIS technology is expanding throughout Maine DOT. GIS is being used not only for combining and geo-referencing various networks, but also for quality control and report generation. The use of GIS as part of the statewide model effort should thus correspond well with the expansion of GIS technology within the Department.

The Statewide Travel Demand Model

Model Overview

The Maine DOT modeling effort uses the TRIPS software from MVA Systematica. In general terms, the development process begins with definition of Traffic Analysis Zones (TAZs), which are generally based on towns and refined using population and other socioeconomic data. Special TAZs must also be defined outside the study area, to enable modeling the travel into and out of the model area. In addition, special generators/attractors like large employers and recreational destinations are identified. A 'trip generation' component is developed that identifies the producers and attractors of traffic. A gravity model takes into account existing traffic volumes, capacities and other roadway characteristics to estimate where the trips originate and end. The model effectively estimates the actual routes taken, and thus the associated traffic volumes along those routes. By changing the model inputs, future travel demand can be estimated and the outputs can be refined based on model calibration.

To develop the statewide travel demand model, Maine DOT performed the following general activities (not necessarily in this order):

1. Acquisition of contractor services in mid-1994 to assist with the model development
2. Development and distribution of a traveler survey
3. Identification and collection of data to be used as inputs to the model
4. Establishment of a plan for linking the travel demand model with GIS technology
5. Development of the model network
6. Development of trip generation, distribution and

assignment models
7. Development of future year forecasts
8. Development of goods movement and mode split models
9. Calibration of the model
10. Establishing links between the travel demand model with the agency's air quality model (Mobile 5a).

The Maine statewide model is based on the 1995 base year, with forecasts through the year 2015. In the current phase of the project, Maine DOT is refining the model calibration. Figure 1 provides a visualization of the model network.

As mentioned earlier, the development of statewide travel demand models is a relatively new endeavor among state DOTs.

Unique Characteristics of the Maine Model

- A large component of recreational travel, with extreme seasonal variations in travel demands
- A strong economic dependence on trucking
- Major employment concentrations
- The presence of the Maine Turnpike as a critical central artery

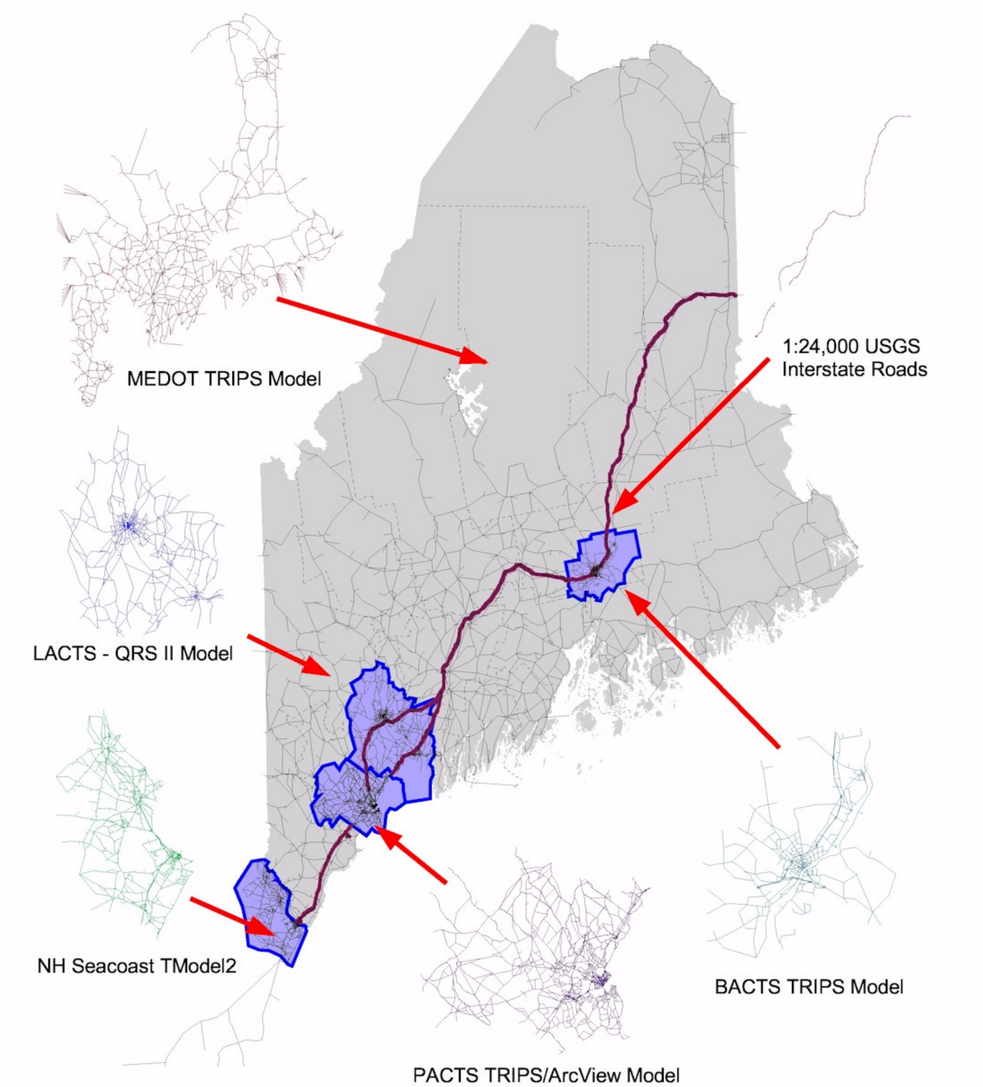


Figure 1. Statewide Model Network

Data Category	Source
Model networks	Four MPOs and Maine DOT statewide model network
Roadway inventory database	Maine DOT
Economic data	Regional economic model (REMI), providing economic forecasts based on manufacturing groups, population, etc. (includes a method of partitioning county-level data into Traffic Analysis Zones)
Census data	U.S. Bureau of Census
Traffic data, truck surveys, commodity flow surveys, and traveler survey results	Maine DOT
Data on lodging and restaurants	Maine Department of Health

Table 1. Data Categories and Sources

Model Inputs

Numerous sources of data were available for development and calibration of the Maine statewide travel demand model. The primary categories of data used for the model are shown in Table 1.

A summary of these inputs is depicted in Figure 2. Development of the model, including the use of GIS for converting and combining the source models, is described in section, "Model Development with GIS."

Traveler survey results were a major component on the development effort. For this effort, two primary surveys were used:

1. Maine Turnpike Survey. Although a household-based survey is usually conducted for metropolitan areas (for developing trip generation rates) and for regional modeling efforts, a Maine Turnpike survey was opted for this project for the following reasons:
   - An important element of the project involved the development of model parameters for recreational travel (impractical to capture through a household survey), and
   - One of the essential objectives of the model was to address the impacts of the proposed widening of the Maine Turnpike.

   Thus, the survey questions would be primarily aligned towards tourist travel patterns. The surveys focused on establishing and estimating:

   - External origins and destinations
   - Trip purpose split
   - Auto occupancy
   - In-state recreational origins and destinations.

2. Roadside (origin-destination) surveys. These were conducted at various locations across the state over the past decade. They were conducted primarily as part of corridor studies or capital improvement studies and included origin, destination and trip purpose. The information gathered was used primarily to check trip purpose distributions during the statewide model calibration process.

Another essential element of the model was traffic volume data. Traffic volume estimates are an essential output of travel demand models. To evaluate the accuracy of the transportation model, traffic counts are required. Maine DOT has a number of permanent and temporary traffic counting stations set up across the state. A database of average annual daily traffic (AADT) volumes is kept for all roadway links in the TINIS database, including estimated values for links with no direct count data. Within TINIS, seasonal factors are also available to estimate average daily sum-

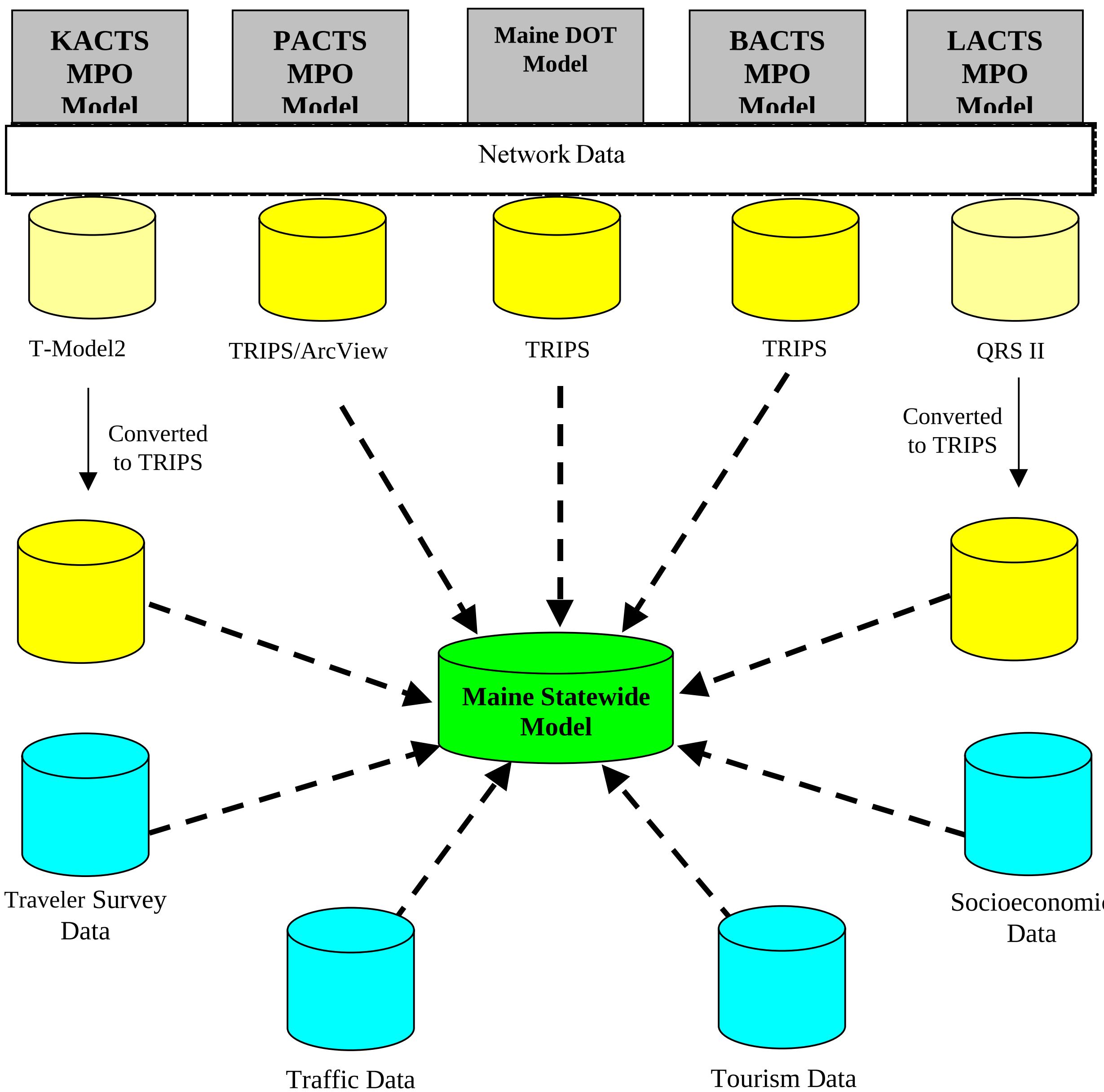


Figure 2. Overview of Statewide Model Data Sources

mer traffic, an important input and output of the model. Traffic volumes were originally entered in the initial statewide portion of the network developed by Maine DOT. As the network has been expanded, TINIS volumes were entered into all links outside of the MPO regions using ARC/INFO to transfer attributes to the model network.

Model Outputs

The outputs of the statewide modeling effort include:

Statewide Modeling Outputs

- Producers and attractors of traffic, including TAZs and special generators (e.g., a specific manufacturing plant)
- Forecasted/projected traffic volumes and related computations (e.g., Vehicle Miles of Travel) - forecasts for 2006 and 2015
- Average summer weekday traffic volumes
- Summer weekday and Sunday peak period traffic volumes.

These modeling outputs will be used for various purposes, including:

- Input to the Air Quality Analysis Package (after some post processing), in particular, as input for analysis related to the widening of the Maine Turnpike
- Forecast of recreational traffic
- Analysis of growth factors (in traffic volume) to feed into the project development process

The forecast of recreational traffic is a particularly innovative aspect of the Maine DOT travel demand model, in that such models are generally linked primarily to population growth. This model emphasizes the special case of very high summer tourist traffic volumes, which increases at a rate not directly linked to population growth. One major issue for the model is, how to produce (generate) recreational trips based on model inputs? This required emphasizing traffic ‘producers’ outside the state, such as the Boston metropolitan area. Another key input to the model is the Average Summer Daily Traffic (ASDT), estimated from the TINIS AADT and directly from the model projections.

Model Development with GIS

An initial statewide TRIPS model network was developed by Maine DOT based in part on the Maine DOT’s 1:24,000 road centerline base map. The base map was used for identification of candidate nodes and links for the model, and to help establish the relationship between the model links and the underlying links coded in the TINIS roadway inventory database. The TINIS data were aggregated to the level of the model links and input manually to TRIPS. The end result was a ‘stick’ network of about 1500 links, with very rough schematic networks for the MPOs.

In addition to the initial statewide network, other data sources were used for developing the full, refined statewide model of about 13,000 links. These data sources included:

- Four existing MPO travel demand model networks (for MPOs PACTS, BACTS and LACTS within Maine, and KACTS split between New Hampshire and Maine)
- 1:24,000 USGS road arcs from MDOT of GIS data. This supplied divided highway and interchange geometry along the interstate and in several configurations outside the MPO networks. These roadway arcs were stitched into the statewide model network.
- Interstate 1:100,000 USGS roads to connect large New England zones to Maine. Rather than external zones, this approach allowed for better modeling of long distance trips.

Incorporation of the MPO models with the initial statewide model was a particularly complex aspect of the model development. The MPO models were in different formats, and used different inputs for trip generation. Some were peak hour models, unlike the ASDT (Average Summer Daily Traffic) basis for the statewide model. Link types were different, and in some cases, these had to be converted to conform to the statewide model link types (based on functional class). Fundamental to the development process was a common geographic coordinate system. All of the pre-existing models used a ‘page space’ coordinate method where the lower left corner was 0,0 and extended to values in the upper right corner around 1000,1000. To facilitate the stitching process and enable integration with other GIS-based data, the state standard of Universal Transverse Mercator was chosen for the statewide model. Each model was transformed and rubber-sheeted using ARC/INFO tools along with the MDOT 1:24,000 base map as a reference. Because of inherent inaccuracies in the original digitizing of nodes, thousands of nodes were moved to their corresponding location on the 1:24,000 base. The use of location names in the MDOT TINIS system was invaluable in this process. To summarize the state of the source models prior to the statewide modeling effort:

- The PACTS and BACTS models used the TRIPS software and were readily displayed in ArcView
- Both PACTS and LACTS networks had to be converted to true coordinate space to be integrated with the statewide model
- LACTS and KACTS had to be created from scratch generate files, as these used different modeling software
- For the KACTS MPO, split between New Hampshire and Maine, the model links had to be allocated to TAZs appropriate for the statewide model.

To overcome these and other inconsistencies, the ArcView GIS software was used to aid with integration of the MPO models. The GIS software enabled:

Improvements by ArcView

- Visualization of the separate models
- Conversion to a common coordinate system
- Edgematching between the separate models in the transition areas

The MPO models, which were developed in the absence of a statewide model, extended beyond their mandated Planning Area boundary before terminating in external zones. MPOs are funded to supply model outputs for their respective regions, but without a clear delineation of model extents, obtaining aggregate statistics is time consuming. Through the statewide model development process, this coordination became easier through the use of GIS maps. In addition, the GIS software was used because the source networks were too large and complex to be efficiently manipulated and visualized in the modeling software.

Transferring Data Between GIS and Statewide Model

The use of GIS for the current project phases served two main purposes: integration of the source networks (as described above), and display of assigned model outputs. The TRIPS modeling software was selected by Maine DOT largely for its graphical interface, which allowed graphical editing of both links and attributes. However, the graphical capabilities of the modeling software are limited compared to those provided by full-featured desktop GIS software. Therefore, it was desired to develop a method to transfer data between the modeling software and the GIS to enable more detailed display and reporting of the model outputs.

The integration of the modeling data with GIS is performed though a set of semi-automated procedures for transferring data from TRIPS to ARC/INFO and vice versa. The base networks are separately maintained in the two software formats, and must meet a set of base coding conditions prior to performing the translation. Currently, the complete model is transferred each time. In the future, the routines could be modified to take advantage of a ‘change file’ function available in TRIPS, whereby only the updates made in ArcView would be transferred to TRIPS for updating the model.

In addition to displaying model outputs, GIS provides a number of other advantages:

- Overlay of the model outputs with other data sources. For example, other geographic layers such as such as town boundaries or socioeconomic data are easily overlaid on the model network with GIS provides much greater mapping detail than with the model network alone.
- GIS also provides better tools for text labeling.
- While the TRIPS software is able to incorporate other layers, the process is laborious and would be inefficient with regard to storing and maintaining data in multiple formats. This is a function easily handled by GIS.
- Transferring the model to GIS format also enables display of the model outputs with other roadway characteristics available in TINIS or other source data sets.

Another use of the GIS was to aid in the conversion of various source networks to a set of statewide standard

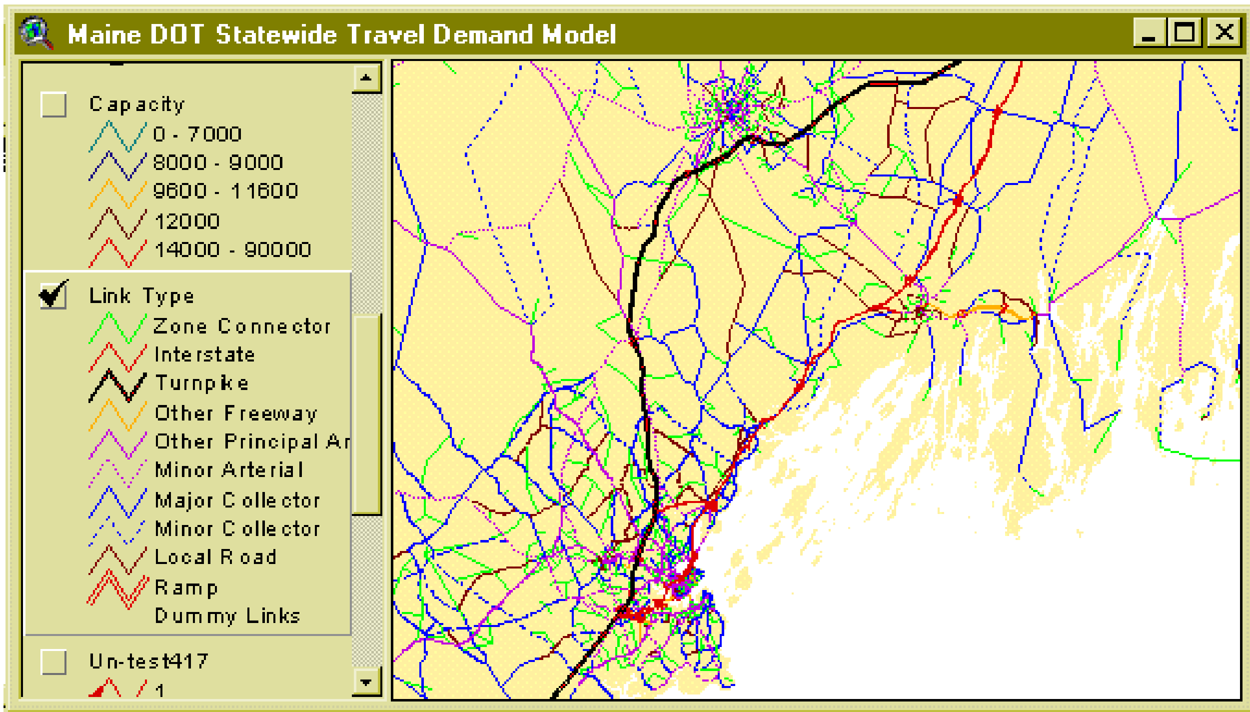


Figure 3. Standardized Link Classification Across Original Networks

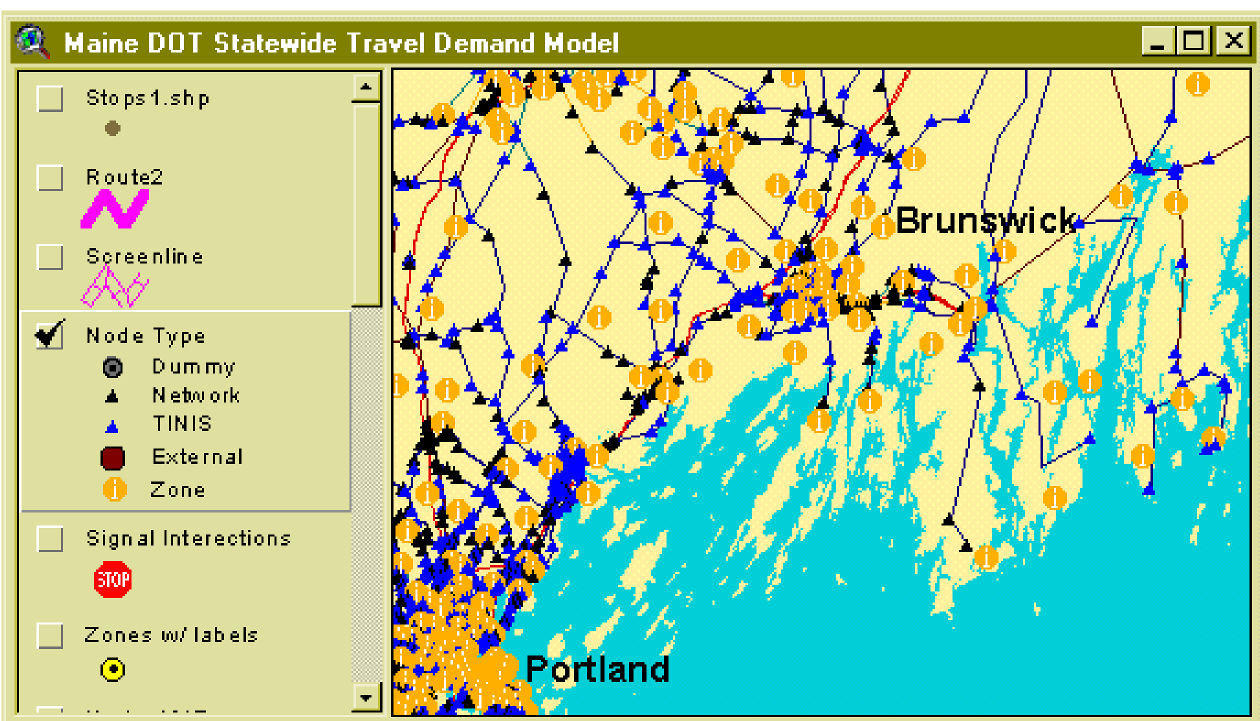


Figure 4. Hierarchical Node Numbering Scheme

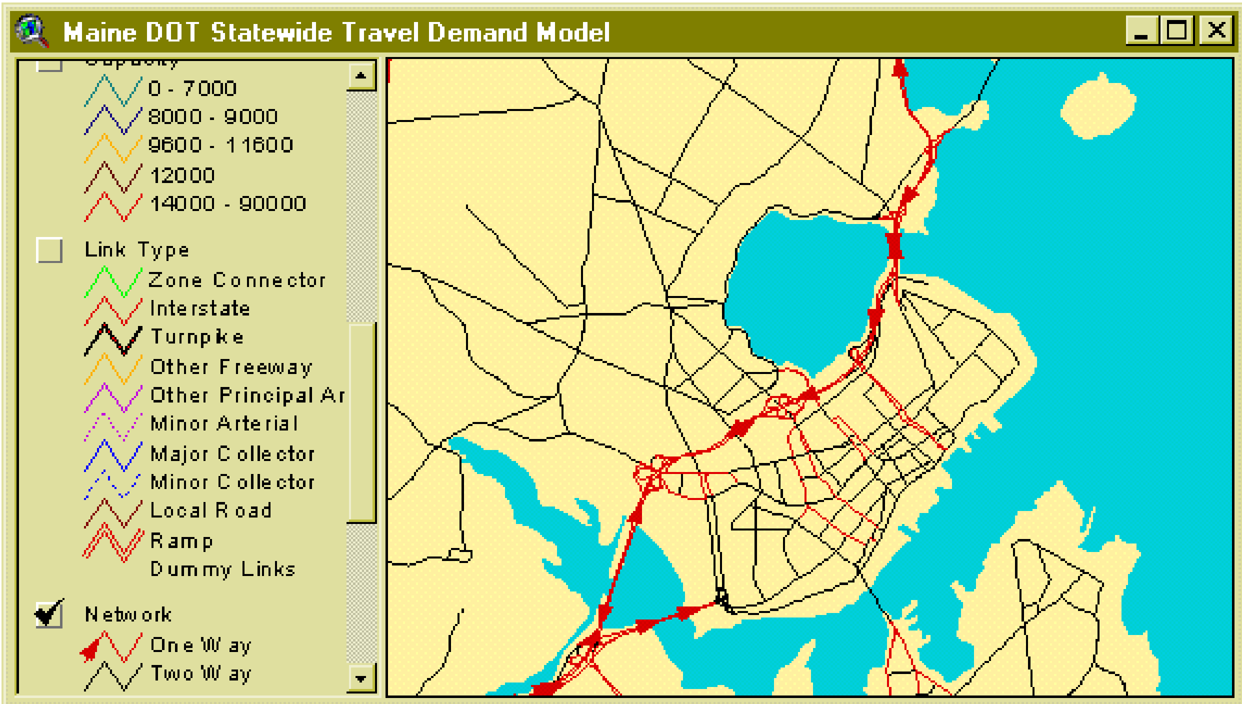


Figure 5. One Way Links in the Model Network

codes. Once the network was properly represented spatially, network coding conventions were standardized and rules were developed for converting between the source models codes to the standard codes of the statewide model. The analysis, visualization and quality control of the conversions were aided by use of the GIS. As an example of the use of GIS to assist with this process, coding conversions were required between the MPO models for link classifications (based mainly on functional class), as illustrated in Figure 3. Another example is provided by the incorporation of the node identifiers used by TINIS within a hierarchical node numbering scheme as required by TRIPS (Figure 4). A third example is the identification and display of one-way links in the network (Figure 5).

Summary: Statewide Model Development and Use of GIS

To summarize, the use of GIS technology for this project provided key tools to help with:

- Complexity of the network – combining the source networks was too complex to be efficiently handled by the modeling software
- Display and Reporting – GIS provided the ability to display and map the outputs assigned by the model, such as volume to capacity ratios, Vehicle Miles of Travel, etc.
- Quality control – efficient visual display of the model outputs enables better comparison of model results to existing TINIS data (AADTs, etc.), which aids in identifying errors and with calibration of the model.

No customized GIS interface is planned for the current phase of the project. Instead, the default ArcView interface is used for display and query of model outputs. This decision was made in part because a more sophisticated interface, including routines for translating network and attribute data to ArcView, is reportedly under development by the producers of the TRIPS software.

GIS is not currently used for directly providing inputs to the data model. However, this is recognized as a potential tool for input of updated data from TINIS and other data sources. At this time, there is no plan for how updated TINIS data will be input to the model, but a fully automated process is desired for efficiency and to assure data quality. Ideally, the process would be streamlined to enable transferring the TRIPS model to ArcView, making edits in ArcView, then transferring data back to TRIPS to run the model with the new inputs. It is likely that GIS will be used to assist in directly updating the model inputs during the next update cycle (anticipated for the year 2000).

Future Project Phases

Several future enhancements using GIS have been identified throughout the project. Potential enhancements to the current model include:

- Enabling direct input of TINIS attributes to update the model (facilitated by GIS)
- Providing a mode choice model (which would require GIS compatibility for display of rail, water, transit and other travel modes)
- Use GIS to conflate the model network to MDOT's street centerline file, to facilitate the transfer of attribute data (including averaging of TINIS values over travel demand model links)
- Enhancing the model by further data collection/ input, and by refinement of the model calibration (visualized with GIS)
- Refining the estimation of trip rates in the current model (e.g., perform a survey to determine household trip rates geocoded with GIS to analyze household distribution).

Project Costs

The total cost of the project was $330,000 with approximately $25,000 budgeted for the GIS/Model development component. Key MDOT GIS personnel were used throughout the project to insure that the product being developed by the consultants would meet the expectations of the MDOT. The GIS personnel also insured that the product could be integrated with the MDOT system when time and resources permitted. This approach of using key GIS personnel as "advisors" to the consultant limited the costs to MDOT's GIS department associated with the GIS/Model development.

In addition to MDOT GIS staff input, a model working group (MWG) was created by the MDOT that represented expertise in each area of model development. The MWG was made up of representatives of the MDOT, MPO's, regional planning commissions and other public and private agencies as well as personnel of the GIS department of MDOT.

The issue of developing a travel demand model that is "linked" to a GIS platform was an issue that was discussed at length in the early planning stages for the development of the model. It was determined that using a GIS package could benefit the MDOT in two ways. Not only could GIS be linked to the model directly to share and display data but it could be used in the development of the necessary highway networks especially in "stitching" the detailed MPO areas into the model. It should be pointed out that the GIS effort was to develop a "framework" to fully integrate the model with the MDOT GIS system at a later date. This was due to the fact that considerable work had already been completed in developing a model network prior to actually beginning the development of the model with the assistance of consultants. The format of the majority of the prior work was not in a form that was compatible to the GIS system at the MDOT. To "step back" and develop an entire new network and other data sets using only GIS would not meet the required time frame for the development of the model.

Thus, the specific cost of developing the framework for integrating the model networks with the GIS is $330,000. Additional costs were incurred in prior years to develop the model networks and modeling procedures, but these are separate from the GIS program.

Project Results and Benefits

At this phase of the project, a comprehensive statewide model has been developed that will meet most of the original project objectives. A standard model has been developed for forecasting traffic growth statewide, which enables evaluation of major capital projects beyond the MPO areas. The model addresses Maine's recreational travel patterns, and provides improved inputs to the individual MPO or regional models and for air quality analysis. The integration with GIS provides for display and quality control of the assigned model outputs, and will likely facilitate updating the model in the future.

Another notable consideration for integrating GIS with the statewide model was the simultaneous development of TIDE, Maine DOT's GIS-linked data warehouse. TIDE will provide a unified source of information for updating and refining the statewide model, and for use with subsequent analyses. The traffic forecasts and other model outputs can be integrated directly with other roadway attributes in TIDE, enabling direct analysis of the model outputs in conjunction with other data sources, such as traffic accidents data and traffic count data. It is anticipated that compatibility with TIDE in the future will maximize the benefits of the modeling effort.

Other potential benefits to Maine DOT's statewide modeling effort include, but are not limited to, assessment of user characteristics, evaluation of border crossing policies, and assisting with operations and maintenance policies.

Lessons Learned

Maine DOT evaluated many of the practical and potential uses for a statewide travel demand model prior to obtaining proposals from consulting firms for the development of the model. A mode choice model, a truck model (truck trip tables) and an air quality analysis post processor were part of the development effort as well as the travel demand forecast model.

1. In hindsight, it would have been advantageous to first develop the travel demand model, and then to develop other products under separate contract(s).
2. The development of the statewide travel demand model required many intensive meetings throughout the development stage of the model. Development meeting were used to discuss and resolve issues that were not foreseen and address other potential issues in the further development of the model.
3. Both financial and personnel resources were used in the development of other products required of the project that would have been better spent on model development itself. Maine DOT realized that the general model output and formats were constantly being changed to conform to the inputs required of other products. The model should be developed for its prime use and the other required products designed using the output of the finished model.
4. Personnel working on the project also became an issue due to the many products required to be developed. During the development period of the model and its associated components, over one and half years, engineers, planners and firms left the project. This was due to "normal" attrition of people pursuing new careers with different firms, but resulted in project delays.
5. Personnel became "spread out" over more of the project's tasks rather than concentrating on anticipated individual tasks as originally assigned. Maine DOT's position is that this would not have happened had it developed a travel demand model only and developed other products later. The travel demand model could have taken less than a year to develop.
6. Developers understated the lack of adequate data. Maine DOT would advise others to explore the idea of requiring the quality of the finished product, for its intended use, to be fully explained and described prior to development. Shortcomings that are known or foreseen due to data limitations should be documented prior to development. Some of the products were delivered to the Maine DOT with the caveat that a better product could have been produced if better data had been available.
7. The decision to link the Statewide Model should benefit MDOT in the future, when MDOT determines that it can be fully integrated with the system. The volumes of data that are needed to drive the model will be easier to access, view and update when the project is completed.
8. All aspects of updating the model, the network data as well as the socioeconomic data will be facilitated using GIS. With a direct link of the model to the GIS platform the ability of the Bureau of Planning to graphically present the result of model output and to further enhance model analysis will become a reality. The only presentation tool that now exists is included in the modeling software and was not designed explicitly for that use.

References

Maine Department of Transportation, 1998. *Maine DOT Statewide Travel Demand Model*.

Bureau of Transportation Statistics Web Site, http://www.bts.gov/gis/, May 1998.

Contacts

This work was performed under contract for:

Travel Model Improvement Program

U.S. Department of Transportation
Federal Highway Administration
Office of Environment and Planning
Washington, DC 20590

The Case Study was prepared by:

GIS Trans, Ltd.
675 Massachusetts Ave, 14th Floor
Cambridge, MA 02139
Phone: (617) 354-2771
Fax: (617) 354-8964
http://www.gistrans.com

For further information please contact:

Bill Croce
Maine Department of Transportation
Bureau of Planning, Research,
and Community Service
16 State House Station
Augusta, ME 04330
Phone: (207) 287-3131
E-mail: bill.croce@state.me.us

Michael Culp
Transportation Engineer
Federal Highway Administration
Office of Environment and Planning, HEP-20
400 Sevent Street, SW
Phone: (202) 366-9229
E-mail: michael.culp@fhwa.dot.gov

Return Address:

TMIP Reports/Kim Fisher
U.S. Department of Transportation
Federal Highway Administration
Office of Environment and Planning
400 Seventh Street, SW
HEP-20
Washington, DC 20590